A new Peruvian-Swiss program on climate change adaptation: advancing towards integrated climate change research, imple- mentation and science-policy dialogue

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The Andes: highly vulnerable to climate change

Mountain regions in countries in development are particularly vulnerable to climate change. These regions need readily available base lines of expected impacts on the regional and local level to be in a position to plan and implement effective and socially consistent adaptation measures. However, the field of climate change impacts and adaptation is highly complex, both on a scientific and on an implementation level. A main reason are impacts on different ecological services and socio-economic systems, and related feedback effects, and a multi-actor environment on different levels of social and political systems. International collaboration is needed to address the key problems.

Peru and the Andes have been recognized to be among the most vulnerable areas to climate change (Bradley et al., 2006, Magrin et al., 2007). In collaboration with the Peruvian Government, Ministry of Environment, therefore, the Swiss Agency for Development and Cooperation (SDC) has recently initiated a program on climate change adaptation (PACC – Programa de Adaptación al Cambio Climático) in two regions of the Peruvian Andes.

Key parameters of PACC

The PACC is implemented by a NGO consortium led by Intercooperation. Scientific support is provided by several scientific institutions in Peru, and a scientific consortium in Switzerland, which includes Meteoswiss, Meteodat, Agroscope Reckenholz-Tänikon ART, the Swiss Federal Institute for Forest, Snow and Landscape Research WSL-SLF, the University of Geneva and is led by the University of Zurich.

The programme focuses on three major thematic lines: (i) disaster risk reduction; (ii) water resource management; and (iii) food security.

Geographically, it focuses on the Cusco and Apurímac regions in the south of Peru between about 3000 and more than 4000 m asl, with mountain peaks rising over 6000 m asl. The population of both regions is around 1.5 million, with about 40% suffering from malnutrition and over 75% having a lack of basic needs. Poverty-related problems are particularly pronounced in rural areas. As a consequence, there is limited adaptive capacity to adverse effects of climate change (Lagos, 2007). The Andean regions of Peru have two distinct seasons, a rainy period in austral summer and a dry period in austral winter. During the dry season, many parts of these regions rely on water resources from glaciers, and rural indigenous people are in fact observing with increasing concern the glacier retreat of the past years and decades (Orlove, 2008).

Relating to climate change impacts, glacier retreat and changing water resources are not the only relevant issues. The picture is more complex. Extreme climatic events such as cold waves have been observed to strike more severely in recent years. The rural population is especially badly affected by loss of crops and cattle caused by cold waves and droughts. In addition to slow-onset climatic disasters (e.g. droughts) magnitude and recurrence of rapid geomorphic hazards such as landslides may be altered due to climate change.

Figure 1: Meteorological and hydrological stations in the Andes are often maintained by local people. Here a campesina explains 'her' station in Sicuani, near Cusco (photo by M. Rohrer).

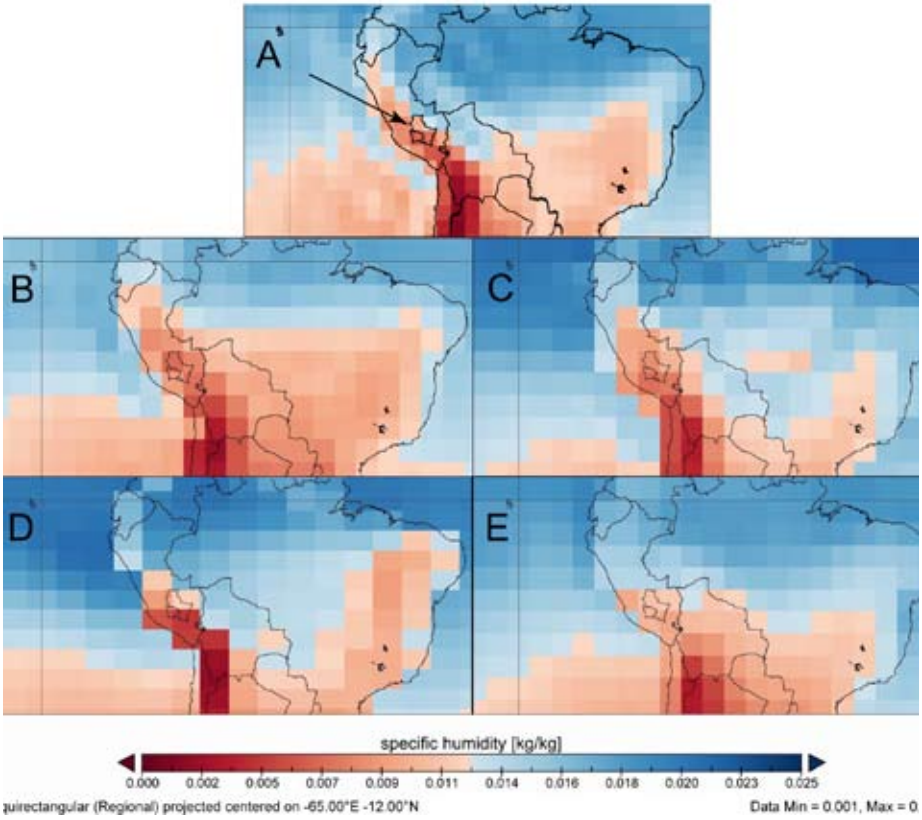

Figure 2: As an example of climate projections, mean specific humidities are shown for June 1980-1999 based on NCEP Reanalysis (A), and for 2046-2065 for SRES-scenario A1B as modelled in the Global Circulation Models for the central part of South America: Bjerknes Center BCM2 (B), Canadian Center CGHR (C), Hadley Center CM3 (D) and Meteorological Institute of Japan MRI-MRCGCM (E). These IPCC-AR4 based results do not provide sufficient detail and clarity as to whether the dry austral winters in the regions of Cusco and Apurímac (geographic limits indicated) will even be drier in future than at present (data courtesy IPCC).

Past and present climate trends and future projections are not understood in sufficient detail for the Peruvian Andes. In general, a temperature increase of up to 0.3°C/decade has been observed but this pattern is not homogeneous (Vuille et al., 2003). For the Urubamba catchment in Cusco the temperature has increased up to 0.4°C/decade (Rosas et al., 2007). Similarly, climate projections for this region still bear considerable uncertainties (Urrutia and Vuille, in press, ~~Fig. 1~~). Hence, there is a strong need to improve the scientific basis concerning the type and magnitude of climate change impacts on the local and regional level using adapted downscaling methods.

Regional scientific basis

Thorough analysis of existing long-term climate series form one of the main basis for further impacts assessments. While most studies on climate change in the Andean region have used monthly climate variables, studies within PACC will include analyses of daily variables. This is particularly necessary for an improved assessment of climatic extreme events and is being done by the Servicio Nacional de Meteorología e Hidrología del Perú (SENAMHI) in collaboration with the Swiss scientific consortium. Long-term climate series date back to the 1960s. However, the scarcity of data in the Andes is challenging, though typical for mountain regions, particularly in developing countries. On the one hand this emphasizes the importance of improving current monitoring networks and on the other hand calls for integrating additional data sources. Satellite data is a primary choice and may include rainfall data from the Tropical Rainfall Measurement Mission (TRMM) or high-resolution optical satellite data for deriving land-cover and glacier information.

Downscaling of future climate projections based on global circulation models (GCM) is an important basis for further impacts analyses (Fig. 2). In the PACC both dynamic and statistical downscaling is applied, the former in collaboration with different climate centers. The methodologies applied for the analyses of current and future impacts differ according to the three major thematic lines. For water resources, for example, a distributed hydrological model (PREVAH) is adapted and calibrated for application on a regional level. The extreme scarcity of gauging station data is thereby a major challenge. For local water resource studies, inventories of existing surface and subsurface water systems are carried out in collaboration with local people.

Science and decision-making dialogue for adaptation measures

The analysis of cross-sector effects through the thematic lines of water resources, food security and natural disas-

ters is an important part of the PACC. This may be illustrated with water resources whose changes have effects across agriculture, forestry, natural hazards, biodiversity, industry, sanitation, and other sectors. It is evident that the program cannot thoroughly study the effects across all the sectors but some of the key impact sectors need to be identified for adaptation. The human dimension, particularly the people's perception, is necessarily integrated in this concept to allow for a more complete view on vulnerabilities to climate change. Only with a better understanding of people's perception of climate change and risks, as well as the perception of different local, regional and national actors will enable an improved design of adaptation mechanisms.

It is particularly important to maintain an integrative perspective in this context because the impacts of climate change are multiple and their severity and potential damage or cost need to be analyzed in an integrated framework. Corresponding methodologies developed in integrated assessment studies (Carter et al., 2007), however, are relatively poorly developed on the local level and therefore need to be advanced. The interdisciplinary and multi-actor environment of the PACC represents both its strength and complexity. The PACC is a major opportunity to improve the dialogue between the scientific community, implementing agencies, and the political sphere to find more sustainable mechanisms of climate change adaptation. The strategy of the PACC is to involve all political levels in the program, from the local community to the regional and national governments. This close integration of the political level is a strength of the program but also a difficulty, in particular for the scientific community which is not too familiar to be directly confronted with this perspectives. In this context uncertainties related to natural and social aspects of climate change prevailing in scientific assessments are often difficult to communicate to decision-makers. While uncertainties have been an important issue in climate science for quite a while, they have only recently been systematically approached in the field of climate change adaptation (Dessai and Hulme, 2007). The key for adaptation projects such as the PACC is to find adaptation measures that are robust against uncertainties but yet feasible to implement.

The global perspective

The lack of scientific base lines for adaptation projects that often are effective on a local to regional level is a serious problem in view of ongoing climate change and the rising adaptation funds through the United Nations Framework Convention on Climate Change (UNFCCC). Those funds should be predominantly directed towards developing countries. The need for scientific base lines on the one hand, and scarce data and observation on the other, is a typical problem found in countries in development and in mountain regions. The PACC should therefore have a catalyst function and contribute to the development of adapted methods that can also be applied in other regions. Collaboration with initiatives and projects in this field is important. In the Andes, the PACC collaborates and seeks synergies with other ongoing programs such as the Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project (PRAA) of the World Bank/Comunidad Andina, the American Cordillera Transect for Global Change Research and others.

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